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RECENT DEVELOPMENTS IN THE APPLICATION OF THE B. D. STARTER

EHRENFRIED E. PFEIFFER

The success of the B.D. Starter in the composting of large quantities of municipal wastes, which has as all our readers know been achieved at Oakland, California by the Compost Corporation of America, has provoked all kinds of interest and inquiry from the owner of the smallest garden to the possessor of heaps of apparently useless sawdust. The laboratory has been working on methods of applying it to specific fermentation problems for the small gardener, the chicken farmer and so on. Techniques and methods which have been tested and confirmed by us are presented in the following material.

INSTRUCTIONS FOR BUILDING A SMALL COMPOST PILE WITH B.D. COMPOST STARTER

The small compost pile does not get the benefit of the grinding action used for large scale composting. Grinders for small pile use might be too expensive, or less efficient than large grinders, or the labor might not be available for feeding the grinder and removing the material by hand. On a small scale, therefore, the usual course is to build the pile without grinding the material.

While fast fermentation is achieved by grinding and inoculating with B.D. Compost Starter and the finished product can be obtained in from 2 to 4 weeks, the pile made without grinding will take longer to ferment as it will take more time for the Starter spray to penetrate the larger particles. Speed, however, is less essential in the small pile than in composting on a large scale where a rapid turnover is necessary.

The following is a description of the building of a small pile from kitchen garbage, lawn cuttings, garden refuse, leaves, etc. It can be done easily in the back yard.

Thick layers of any one material will heat up and may fail to produce a well conducted fermentation. Leaves and grass cuttings have a tendency to cake and exclude the air which is necessary for odorless aerobic fermentation. The best way to build a pile is, therefore, to build *thin layers only* of any one kind of material and to alternate the materials.

The piles should be started on bare soil, not on vegetation and especially not on grass sod. A suitable place for the pile

should be selected and the vegetation or sod removed.. Also remove the top foot of soil. This soil can be used later for covering the finished pile or for interlaying the growing pile.

The "critical" size for the pile is 12′ wide and 5′ high. It can be as long as desired. Beyond the specified height and width air does not penetrate the center of the pile, causing slow fermentation and odors at the core.

Begin to build the pile by spreading a thin layer (not more than 2″) of garbage, grass cuttings or other materials. Each day's production of kitchen garbage can be added by spreading it out in a 2″ layer. In this way the pile will grow by degrees to the proper width, height and length. After a complete layer 2″ thick has been formed, sprinkle a thin cover of soil over the entire surface, like sugar on a pie. It is all right if the kitchen garbage contains some paper. If there is not enough garbage on hand, the layer can be completed with grass cuttings or leaves. Grass cuttings especially should be piled very thin. Leaves can be raked together, stored in a separate pile for the time being, and dispensed from this stockpile while building the new compost heap. In other words, the idea is to proceed as though making a layer cake. During the building period the pile should be covered as a protection against flies, roving dogs, etc. This can be done by spreading an old burlap or mat over the pile and removing it when more raw material is added. Sometimes dogs or chickens may get at the pile. To prevent this, a roll of chicken wire over the pile will do the trick. The best way to eliminate rats is to put out a rat trap, well spiced with Warfarin as bait.

Application of the B.D. Compost Starter:

For best results, the B.D. Compost Starter should be sprayed in a fine mist over the entire surface each time new raw materials are to be added.

The Starter is furnished in a dry concentrated form. Moisten half a level teaspoon of dry Starter the evening before, letting it stand over night in a cup of water at room temperature. Dilute this the next morning with 2 quarts of water and stir or shake well before using. Clean spray apparatus thoroughly with water, as any residue of other material may destroy the effectiveness of the Starter.

Spray the solution with a suitable sprayer over each layer. A spray can may be used. A hand pressure sprayer gives a finer distribution of the Starter solution, which is more effective.

Make a new solution each time it is to be used. Once the water is added to the Starter, it should be used at once. It should not be stored nor held for more than one day, as it loses its effectiveness. In water, the bacteria will begin to grow, some will outrun the others, and unless they get to work at once in the compost, the mixture will lose its proper balance. Any unused portion of *dry* Starter can be stored almost indefinitely, if kept in a cool place and not exposed for an extended period of time to direct sunlight.

If kitchen garbage or other material is added each day, spraying the Starter can be done every day or every other day. In either case, be sure that each layer gets a spraying. Not too many days should go by, in any case, before the new material is sprayed. This keeps the fermentation going in the right direction from the very beginning. Unfavorable processes may otherwise get started which are difficult to correct and should be avoided.

In handling a larger amount of material at a time, 1 oz. of B.D. Compost Starter is sufficient for 1 ton of material to be composted. One ounce of dry Starter is 9 level teaspoons, or 3 level tablespoons.

DECOMPOSITION OF SAWDUST AND WOODSHAVINGS

General Information

Sawdust, woodshavings, and in general all raw materials containing a high amount of cellulose and lignin, decompose slowly if left alone. It has been found that the addition of nitrogen in the form of ammonium sulfate, nitrate or otherwise, will hasten the decomposition. Organic nitrogen from wastes, such as garbage, sewage sludge, plant refuse and manures of any kind, will produce in mixture with sawdust a favorable medium for fermentation. The B. D. Compost Starter then will speed up the fermentation and produce humus in a reasonably short time, ready for direct application on the land, without adding other nitrogen to the soil and without tying down nitrogen in the soil. The tying down of nitrogen and bacterial action in soil was one of the handicaps in the past which made the use of sawdust on farms impractical.

In order to get the best results with the new bacterial breakdown of sawdust it is necessary to mix the sawdust with other source materials. These will act as foods for the inoculated

bacteria, stimulating their growth and multiplication, which in turn will break down the cellulose. There is no trouble, according to our experience, in breaking down the lignin fraction of wood (sawdust). In fact, lignin with the B.D. Starter has been fermented without additional nitrogen sources. It is the cellulose which needs attention. Only very small amounts of natural nitrogen sources are needed in connection with the B. D. Starter. It is, however, necessary, in order to obtain optimal results, to mix the material to be added as thoroughly as possible with the sawdust.

On a small scale (home gardens or farm use of sawdust-composting) this can be done easily by shoveling the materials together or using a mechanical manure loader attached to a tractor.

In large scale lumber operations, a mechanical set-up for mixing and processing is advisable.

The mixture of sawdust with other source materials can be adjusted to the availability of the latter. We have tried successfully the following mixtures. This does not mean that no other can be used.

Suggestions:

1. Sawdust 80%, soil 20%
2. Sawdust 80%, manure 20%
3. Sawdust 70%, manure 20%, soil 10%
4. Sawdust 70%, garbage, sludge or plant refuse 30%
5. Sawdust 60%, garbage 20%, manure 10%, soil 10%
6. Sawdust 50%, cannery waste 40%, manure 10%

These mixtures are given in the order of speed of fermentation, the higher numbers being the best.

Admixtures of sawdust to other organic materials of high moisture content, such as cannery waste, i.e., moisture higher-than 80%, is especially beneficial for the breakdown towards a fertile humus.

It should always be kept in mind that sawdust (cellulose) is of low fertilizer value and acts at its best as a soil-conditioner, improving the soil structure rather than adding plant nutrients.

We may mention that wood bark can be treated likewise and will have a much better fertilizer value than sawdust. Therefore, in the mixtures suggested a fraction of wood bark will always be beneficial.

Theory: Sawdust contains less than 0.5% nitrogen. Good compost, i.e., humus, will be obtained with organic material of

better than 0.5% nitrogen. The best humus of high fertilizer value will be obtained with source material of 1% to 1.5% nitrogen. High nitrogen content will lead to losses of nitrogen unless specific precautions have been taken.

The bacterial B.D. Compost Starter acts well at any level of nitrogen and can be adjusted to specific tasks and mixtures. However, using the suggested mixtures will hasten the speed of fermentation. A final analysis of the finished product will then determine how much of it should be applied per acre. We repeat that the bacteriological compost will not tie down nutrient, bacterial action and nitrogen when applied to the soil and disked or plowed under, but its nutrients will be available at once.

METHOD OF COMPOSTING

1. *Small piles for garden and small to moderate sized farms*: Mix the sawdust with available organic material, approaching one or the other formula suggested. While mixing, add the bacterial B.D. Starter as a fine spray from a hand or power pressure sprayer and take care that the spray hits as many particles of the sawdust mixture as possible.

The mixing and building of a pile can be done by hand in a garden, or with a power manure loader or scoop hitched to a tractor. The spraying can be of almost any type, provided that the spray nozzles are wide enough to allow the Starter solution to pass in fine droplets. Split nozzles have been most practical, but an ordinary garden hose spray nozzle will do.

For each ton (or cubic yard) of sawdust mixture, one ounce of the B.D. Starter is needed. The Starter is suspended in water (see special instructions for Starter use). The amount of water to be used depends on the type of spray equipment. Use as much as is needed to spray each cubic yard or each ton thoroughly while mixing or building pile. Suppose the pile holds 10 tons and takes one hour to build, then the amount of water discharged during this one hour is the amount required for 10 ounces of Starter. In one case this may be 5 gallons, in another 20 gallons, which can be determined by checking the speed of discharge of the sprayer. If a pile has already been built, follow our instructions for small piles.

IMPORTANT: In order to secure an aerobic fermentation, the piles should not be larger than 12 feet wide at the base, 4 to 5 feet high and as long as desired. If the raw materials are dry, a thorough sprinkling of water is needed. If in time

the piles get dry, they should be watered at intervals. They should never dry out entirely, for dry materials cannot ferment.

2. *Large Sawdust Composting Piles*: For large sawdust piles, mechanical equipment is necessary. This consists in general of a loader, conveyors and a hammer mill for mixing, which discharges on another conveyor and loads a dump truck. The piles can be built with a dump truck or loader. This procedure applies where stockpiles are already present.

Details of mechanical equipment can be worked out as soon as the Laboratory knows the amount of sawdust to be processed per hour, day or year, whether other materials are available for admixtures, what kind and in what quantities.

The procedure of handling and building the large piles, as well as using the B.D. Starter, is similar to the small pile procedure, except that a large power spray will be needed in the case of a large production. All details in connection with the use of the bacterial B.D. Starter can be worked out as soon as we know the amount to be processed in a given period of time.

There is no essential difference in processing hard or soft wood sawdust. The handling, inoculation and piling of sawdust can be streamlined, with a minimum of equipment, by loading or blowing the sawdust on a dump truck and piling it as it comes along. The bacterial treatment can be done while loading and dumping, from a spray rig attached to the dump truck. A frontend loader can mix in the other addenda.

In all these cases the piles should not exceed the critical size of 12′ at the base and 4′ to 5′ in height, in order to maintain aerobic conditions. Large piles need much more time and/or frequent turning over.

3. *Direct Application of the sawdust to the soil*: The method of direct application to the soil is probably the most simple. In this case the sawdust should be broadcast with a spreader over the soil and at the same time a sprayer attached to the spreader could spray the bacterial Starter. The rate of sawdust per acre at present has not been finally established, but is between 2 to 6 tons per acre. The rate of bacterial spray is 4 ounces per acre diluted in 2 to 20 gallons of water, according to the speed of discharge to be used. The bacterial spray has done very well when applied to green manuring, stubble, straw, cotton and other crop leftover.

For successful breakdown in the soil, it is necessary that the soil should be moist or irrigated and the discing or plowing

under is done at once, if possible the same day as the spray is applied. The sawdust, in case of large acreages, can be spread over a period of days and even left on the ground for a while, but the spray should be disced or plowed under at once.

On better soils which are otherwise well provided with organic matter, no tying down need be feared. On poor soils additional fertilization with manure, compost, commercial compost products such as ComCo, sludge or nitrogen fertilizer may be needed, but with B.D. Starter the required amount will be considerably less. Manure, composts, wet sludge at the rate of 4 to 5 tons per acre, ComCo Soil Builder (at the rate of 1 ton per acre) will be sufficient. The maintenance of proper moisture conditions is essential for fast action. Irrigated soils will be ready for the next crop after 4 to 6 weeks.

On acid soils the application of softwood sawdust will need liming at the rate of 1 ton per acre (not more!) which can be done before, during or shortly after the spreading of the sawdust. Dolomitic limestone is preferable on account of its magnesium content. Badly drained soils should be avoided as their acidity might increase with decaying sawdust. Nitrogen fixing bacteria which are contained in the bacterial spray become inactive if the pH is below 5.8 and the fast breakdown without tying down of nitrogen will not take place. (Hence our suggestion of liming.) This danger does not exist with composted sawdust as outlined under No. 1 and No. 2, for fermentation will turn it neutral or even alkaline. However, a small addition of lime (100 pounds per ton) will also favorably influence the composting process.

THE TREATMENT OF POULTRY MANURE WITH B.D. COMPOST STARTER

Poultry manure as well as any other bird manure presents a certain problem because it has a high content of nitrogen, which changes into volatile ammonia, decomposes easily with loss of nitrogen and production of bad odors, and may contain a high amount of moisture which handicaps aerobic fermentation.

The underlying theory is that any organic material or manure which contains more than 1.7% nitrogen and has a tendency to develop ammonia will, in its untreated form, gradually lose all ammonia nitrogen unless stabilized. Furthermore, poultry manure may contain many disease germs which should be

destroyed by means of composting. The preservation of nitrogen as well as the elimination of disease germs can be accomplished by aerobic fermentation. This, however, is possible only if the pure droppings are mixed with other source materials in order to secure a loose structure (aeration) and to absorb excessive moisture as well as to "dilute" excessive nitrogen to the stable proportion, thus avoiding the formation of ammonia.

Experience has proved that pure droppings alone, without the admixture of other materials, cannot be composted to produce a satisfactory product. Chopped straw, sawdust, wood shavings, peat, cotton waste or other fibrous wastes, all with a low nitrogen and high cellulose content, are ideal admixtures to add to poultry manure because they fulfill the conditions required; namely, the balance of excessive nitrogen (ammonia) and excessive moisture. Any proportion of admixture is possible. The amount of the materials to be added can be determined by the trial and error method, or a good guide is to keep the total nitrogen of the mixture below 1.7% and the moisture below 60%. This would require analysis of the raw materials to be used.

In practice there are several methods of approaching the problem of composting poultry manure:

1. In cases where any kind of litter is used, remove the poultry manure and litter from the houses at suitable intervals and build compost piles. It will be a definite advantage to mix it with other materials, as mentioned above, and by all means with at least 10% soil (any). In case of small amounts such piles can be built by hand. In the case of large amounts, a suitable grinder should be used to grind and mix all raw materials. In the case of small amounts, instructions for the small compost pile can be followed. In the case of large amounts it is necessary for us to know the amount of manure to be treated and the kind and amount of other raw materials and "fillers" available. This will enable us to work out a suitable program to cover the specific problem. The B.D. Compost Starter should be added at the rate of 1 ounce per ton or cubic yard of mixture *while mixing or grinding.*

2. In case the droppings only are collected (from wire cages for example), the droppings should be mixed with other source materials as mentioned above. A suitable mixture can be suggested as soon as we know the kind and amount of other materials available. *Pure droppings alone cannot be treated*

successfully. One mixture that has been successfully tried is 30% poultry manure, 50% garbage, 20% soil; another mixture, 30% manure, 40% garbage, 20% dry sewage sludge, 10% soil. In general all mixtures will do well if not more that 25% to 30% droppings are used. In areas where it is possible to obtain cheap sawdust, peat, cotton waste, up to 50% of these can be mixed with 40% droppings and 10% soil. Rate of Starter application: 1 ounce per ton of mixture. Many different types of mixtures are possible. There might be one handicap in bacterial treatment of poultry manure where large amounts of poisonous disinfectants have been used which have penetrated into the manure and litter.

3. It is possible to treat manure and litter by spraying the B.D. Compost Starter directly on the floor of the house once a day or every other day in order to start a favorable breakdown immediately. A teaspoon of Starter diluted in water is sufficient for a house with 100 to 200 hens. However, this treatment is still in the experimental state and needs some observation. No harm is done to the birds by the spraying. Rate of Starter application should be determined according to the surface to be treated or according to the size of flock.

4. Some houses are built in such a way that the droppings fall through a screen, inaccessible to the birds. In this case, the Starter can be sprayed over the entire surface of the droppings. In addition, a small amount of soil, like sugar on a pie, should be sprinkled over the surface. This has been tried successfully on a rabbit farm over rabbit manure and urine droppings. The treatment helped to avoid odors and the manure rotted readily. There is no reason why this could not work out in similar situations with poultry manure. The amount of Starter is regulated by the daily production of manure and the surface to be treated. (The height of manure which is added each day may be measured in inches or fractions of an inch.)

In the case of No. 3 and No. 4, the manure does not need to be removed every day but a sizeable pile could be accumulated.

Once the manure is removed from the house after treatment and it appears not to have completely decomposted, it should be treated again according to suggestion No. 1 or No. 2, but it is possible that the initial inoculation will be sufficient. In this case the entire poultry manure might act as inoculant for the mixture. This needs further observation, however, and we cannot make a definite statement at present.

Each problem should be studied separately to determine which method should be used.

THE BACTERIAL TREATMENT OF PEAT AND MUCKLAND

There are two ways to approach the treatment of peat and muck to produce a bacterized organic fertilizer.

1. The first is treatment in the field, peat bog or muck area itself. This calls for investigation of the acidity (pH), the total nitrogen content of the bog or muck in question, and its content in lime.

If the pH is below 6.0 and no lime or very little lime is present, the bog should be limed with at least 1 ton of agricultural limestone or dolomitic limestone per acre. The latter is preferable. Then soya beans (in a southern or moderate climate) or other fast growing legumes such as vetch or Canada field peas (in a northern climate) can be sown in spring. When these plants have grown to full size (green, in bloom but not in seed), they can be shredded. The Bacterial Starter is applied as outlined in our instructions for field spray on green manuring. The plants are disked or plowed under at once.

The land may need one or more diskings.

The surface layer of the peat or muck area would be ready for use in about 3 to 5 weeks, either for planting a crop or for hauling away. We have observed that this material, to be "harvested" during late summer or fall will make a very fine bacterized peat and can be used as is, or mixed with rock phosphate or other ingredients.

It is also suitable for admixture to garbage or other organic waste composting materials. Frequently a nitrogen content, dry weight, of 2% can be obtained, making it ideal for admixture.

An essential part of this procedure is that the bog or field be well drained.

To make it perfectly clear: this method can be applied to the "mining" of peat bogs and muck land as well as to their improvement in order to plant crops on them.

2. A bacterizing of peat and muck land is possible also by means of excavation of the source material, putting it through a grinder and shredder, adding the B.D. Compost Starter with spray equipment while grinding. In this case,

the bacteria are incorporated in the peat when it comes out of the grinder or mixer. Unless the peat is subsequently stored in piles like the fermentation in our garbage composting process, namely 12 feet wide as a maximum at the base, 3 to 4 feet high, and as long as desired, no assurance can be given that the bacterial action will continue throughout the pile. If these dimensions are exceeded, aerobic conditions can not be maintained in the core of the pile. In this latter case, the bacteria may possibly assume a latent state and become active again when the peat or muck is added to the soil.

Another way of adding the bacteria spray would be at the time of bagging or baling, immediately prior to shipment.

Peat or muck is also a good raw material for the general garbage composting process and can be used in amounts up to 30% of the entire garbage-manure-soil mixture. In areas where peat or muck is plentiful and cheap, it can be substituted for manure and/or soil in such mixtures.

It is excellent as litter in barns or poultry houses and can be treated there by following the instructions for use of the Compost Starter in loafing barns or manure piles.

In all cases where peat and muck are used, their moisture and nitrogen content should be considered in working out a suitable formula for the mixture. 1 oz. of B.D. Compost Starter is sufficient for 1 ton of source material of moderate moisture content (40 to 60%). Very wet peat containing up to 80 or 90% moisture should be allowed to dry a little before use. One ton of very moist peat may thus contain 1600 to 1800 lbs. water and in such a case 1 oz. of Starter should be used for 2 tons of "peat."

Peat is not a suitable admixture for sawdust, while muck soils can very well serve in a mixture with sawdust. The total organic matter content is the decisive factor. Muck piles with 70% or more organic matter are treated like peat, while muck soils with less than 40% organic matter can be the same quality as other soils. Muck soils from bottom land under water or from the bottom of ditches and canals should be dried and exposed to the air in shallow piles before use, in order to counteract the tendency toward anaerobic fermentation. Acid soils and peats should be treated with the addition of ground agricultural limestone, 100 lbs. per ton usually being sufficient.

GOLDEN ACRES APIARY

URSULA STUBER

It was a serene day in late summer. I was sitting in the grass, watching bees fill the air with their dancing gestures. They had not quite settled down yet; for, only a few hours had passed since we had brought them in by truck. But some of them already were gliding into the hive, wearing pretty golden trousers. I took this as a message, that the little honey-makers had accepted their new home and were already beginning to take care of their brood. For, the golden trousers are nothing else, but pollen from the flowers with which young bees are being raised.

I do not know how long I had been sitting there, fascinated by this buzzing diligence that I was witnessing and by the delicate fragrance of nectar turning into honey. Then, when a reddish golden hue spun around the glistening wings, the buzzing grew fainter; and soon there was only silence to meet the growing dusk.

I felt a little silly, musing how to run these colonies where they seemed to know exactly how to organize their lives themselves. I even had the disagreeable feeling that the bees were laughing at me.

This happened about two years ago. I had read many books about the life of the bee; and so I finally plunged into the practical side of the subject. I was, indeed, fortunate to soon find an old apiarist who was willing to show me the practices of beekeeping. He probably had never read a book on the subject; but his practical knowledge could very well fill many volumes. He is still coming by once in a while to help me out with newly arising "bee-problems"; for, every year in beekeeping is a little different. And so, there are still quite some gaps in my knowledge of bee-managment. However, I should like to tell here of the experience I have gathered during the past two years.

The six beehives I started out with were Black Caucasians. I chose this particular breed that time because of their hardiness in view of cold winters. Six months thereafter, by way of division, I increased the colonies to ten. Last year I acquired seventeen more hives; but this time Blond Italians. I am very fond of these pretty, blond bees. They are of very gentle and pleasant temperament. Also, it is much easier to spot their

queen than that of their black cousins. And anyone who ever handled bees, knows the full meaning of that. Also, the Italian queens are not bashful about revealing their age. In their youth they are of a light orange yellow colour. As time wears on them, they turn darker until they are almost russet coloured. The black, Caucasian queen conceals her years with a never-changing dress of black. Her subjects have a quick temper which at times flares up quite unpleasantly; but their vigour carries them well through cold winters. The blond bees are more delicate and have to be protected from the cold. Nevertheless, I give both breeds a winter-cover of straw-filled sacks, which I put into an empty super on top of the hive. This is to provide for surplus warmth, which in turn cuts down the food-consumption of the bees during the quiet season. Although, occasionally, the supplies of a few hives have to be replenished with sugar water in November or March. The feeding takes place from a glass jar covered with cheesecloth. This jar, containing two parts of sugar dissolved in one part of water, is placed up-side down over the little opening of the inner lid. Then it is enclosed by an empty super, covered with the outer lid. Contrary to health-inspired thoughts, no raw sugar can be used for feeding bees, since such would cause diarrhea due to certain gums it contains. Dissolving the white sugar in a very weak tea of camomile has been recommended to me; and I shall try it this fall. However, when harvesting the honey, I always leave a sufficient amount in the hive, so that necessity for feeding arises very rarely.

There is another virtue that I find in the Italian bees—their lack of excessive "Wanderlust"; whereas the Caucasians are frequently seized by violent swarm-fever. Alas, swarming —I have learned a most successful method of swarm-prevention. First of all, the queen has to be confined to the bottom hive-body by way of a queen excluder. This is a grill where the rods are spaced wide enough to permit passage of worker bees, but not of queens and drones whose bodies are bigger. By restricting the queen's activity, which consists solely of laying eggs, to one brood-chamber, the other stories are kept free of eggs and larvae. This not only simplifies the harvesting of honey, but is also a time-saving factor in the prevention of swarms. It is while cherries and clover are in bloom that the bees are most apt to swarm; and during this period of increased honey flow it is important to have a complete picture of the queen's doings.

During this time I search the brood-chamber for queen cells every ten days. These cells are of droplike structure, comparatively large in size. Queen cells built along the edges of the comb mostly indicate intention to swarm. Cells located in the middle of the comb surface are many times a sign of supercedure; but to this I shall come back later. In order to prevent swarming, I destroy the queen cells. By doing this, I force the bees to delay their departure; for, they will not swarm out with their old queen unless they have inaugurated a second one, who will stay in the hive with the younger bees. So, they start all over again, trying to raise a new queen. They keep up their efforts until the honey-flow diminishes and with it their desire for expansion. This method of swarm prevention has proven highly efficient.

Each hive is marked as to the date on which the particular queen began her activity. After two years she has to resign; sometimes later, if she is exceptionally good; sometimes before, if she has undesirable qualities which she transmits to her offspring. Eventually, I intend to raise my own queens. However, so far I have encouraged superceding, in which case the bees on their own replace an old or weak queen with a young one. As mentioned before, one can frequently recognize a colony's desire to supercede by the particular position of the queen cells. Also, these cells are built with greater care and are prettier than swarming cells. In some cases I have taken the chance of placing newly hatched queens or mature cells into the hive. Weak colonies usually accept queens introduced in such manner; strong colonies are liable to kill her. If no cells are at hand, I give the queenless colony a frame with young larvae, from which the bees raise a new queen. To make certain that the bees really are rearing a queen, I examine the frame of brood one week after it has been placed into the hive. If there is no queen cell in the middle of the comb surface, I add another frame with young brood; for, only from young larvae can the bees raise a queen. However, I have not yet sufficient knowledge of this procedure to be able to discuss it here. But, as mentioned before, I am planning to try it.

It was the first year that we had our colonies, that on an evening we stopped to see a beekeeping acquaintance of ours. We found him bending down in front of a door, manipulating something through the keyhole. It looked very mysterious; but his eyes, tensely fixed on the keyhole, convinced us of the im-

portance of the operation. After standing there for quite some time, wrapped in silence and wonderment, our friend removed a kind of spraygun from the keyhole and hastily plugged it up with cotton. He obviously was relieved now. What had he been doing? Oh yes. Yesterday, he had extracted honey from his six hives; and in the room behind the keyhole were stored the empty combs. We had just witnessed their sterilization by cyanide gas, in order to keep them free of wax-moths.

"It is very dangerous, don't you know." He added.

"Does one have to do that?" I asked timidly. Yes, certainly one had to do it. There was no other way.

For days I found myself thinking about cyanide gas. Somehow, it made me shudder. But then, my teacher, the old apiarist, showed me how easily the problem can be solved.

After the honey is extracted, I return the empty combs to the bees, letting them worry about the wax moths. This way, the combs are kept clean without cyanide gas. In November I take the frames off to be stored in a cold place, thereby again, being safe from the wax moth.

So far, I have not encountered any disease, except paralysis in one colony. Those bees inflicted with paralysis, as it is commonly called, are unable to move their wings. They just crawl around, unable to gather any honey. The bees inherit this disease from their queen, but will not transmit it to neighboring colonies. In our case, I changed the queen; and very soon the diseased bees died out, the young stock being healthy and vigorous.

Now the time has come again, when the bees cluster around the goldenrod, sucking the last drops of nectar—the last gift of summer. And soon they will all gather to dream through winter in their castle of fragrant gold.

HIGHLIGHTS FROM THE B.D. CONFERENCE 1952

FRED HECKEL

A lively and businesslike group of more than 100 people from many States took part in the annual Bio-Dynamic Conference, July 27-30th, held as in previous years at Threefold Farm, Spring Valley, N. Y. To a veteran observer of these gatherings the practical and humanly speaking "dynamic" character of the sessions was due at least in part to the fact that the open-

ing remarks of Dr. E. E. Pfeiffer were taken seriously by those present.

Dr. Pfeiffer, scientific adviser to the Bio-Dynamic Farming and Gardening Association, Inc., which organized the meeting, said in his words of welcome:

"The purpose of this conference is to make those who are here more familiar with problems of soils and growing crops. In some other years we have spent quite a bit of time exchanging nutritional experiences. This year we shall work on questions of soils, crops, fields, farm management, plants, compost. Let us not go beyond these assigned subjects. It may also, perhaps, profitably be added that we like to be *matter of fact* in the B.D. movement, exchanging actual experiences rather than opinions, fancies, hobbies."

"There is a problem," Dr. Pfeiffer continued, "in the fact that our approach not only differs from the 'mineral' approach, it differs also from the approach of what is called 'the organic gardening and farming movement.' To speak of 'organics' in general is as much of a generalization as when we talk of 'fertilizer' in general. It is necessary that people begin more and more to develop a *science* in this field—that they do not believe that if they simply set up a heap of mixed plant materials and earth and let it rot down this will give them 'organic fertilizer'."

He went on to point out that the "humus theory" itself was nothing new, having been widespread among both growers and scientists before Liebig 'the Father of Chemical Fertilizing' changed the course of farm and garden practice a hundred years ago. At that time the leading humus exponent was Thaer. The speaker showed, however, that the humus approach was still older, noting that he had in his library an old farm and garden book from Medieval England, which included nice directions for compost-making, and similar material.

The speaker traced the rise and decline of the Liebig NPK theory during the past century, and went into the origins of Bio-Dynamics, beginning with the contributions of the late Dr. Rudolf Steiner, who laid a foundation of a new, scientific approach to soil and plant problems, developed in practical use and proven scientifically in the Laboratory (see Bio-Dynamics, Summer 1948) by Dr. Pfeiffer and others. He traced also the work of Sir Albert Howard and his development of the Indore Method of composting.

Stress was laid on the importance, for farmers and gardeners, of knowing something of the difference between *organic matter* and *humus*. It was pointed out that organic matter includes leaves, stems, branches and twigs, fruit, leaves, seeds and roots, and all sorts of offal such as sawdust, animal organs, meat and animal and human excrement. This material will break down and in the end disappear in the form of gases and water, leaving behind only certain minerals. Such a breakdown is natural, and will always take place if not arrested. *Humus*, the lecturer went on to say, *is a specific state on the path to this breaking down.*

"The breakdown process is interrupted. Humus is a stabilized organic matter, i.e., *the breakdown process is interrupted by a building-up process.* There are bacterial organisms which perform the breakdown process, supported by enzymes. Other bacteria, supported by hormones, do the building up. Humus is, therefore, digested organic matter at the building-up stage."

Pointing out how lack of knowledge of these "facts of life," leads to trouble, Dr. Pfeiffer told of frequent instances of people having bad results with organic practices and sending to his laboratory samples of the compost they used.

"People argue, 'It was all organic—we used leaves, grass cuttings, etc.'", he continued. "To the scientist such illusions are not helpful. Often people produce compost which does not satisfy in its results as to growth. Even professors at the universities sometimes make a mistake here: namely to regard all rotted-down material as 'organic matter', to make comparative tests as against chemicals, and then say they can find no difference in nutritive values of the produce, etc.

"What the compost maker has to produce to get good results is *stabilized humus.* The Bio-Dynamic Preparations are part of the process we use to direct the micro-life in the soil or the compost pile towards the building up of humus.

Full credit must be given to Rudolf Steiner for preparations which have been used successfully for more than 25 years although it is only in the last few years that we came, through research, to know *how* they work.

"It is on these two phases (breaking down and building up) in the production of organic fertilizer, and on the control of these phases, that your soil and crops depend."

The first afternoon of the conference was devoted to visiting some home vegetable gardens, and to the annual meeting of the

Bio-Dynamic Farming and Gardening Association, Inc. At this meeting it was announced, among other things, that Fred Heckel, who has, with Alice Heckel, been co-editor of the quarterly Bio-Dynamics for several years, had proposed a change which the Board of Directors had accepted. Alice Heckel, who has for the past year been doing most of the work of getting out this magazine, is now editor,, and Fred Heckel assistant editor. Peter Escher, who is associated with Dr. Pfeiffer in his nation-wide fertilizer activities, is news editor of Bio-Dynamics.

Interesting, factual reports of farm and garden experiences and problems, by association members and other conference participants, occupied most of the meeting time. Speakers included Milton Wend of Sandwich, New Hampshire; Charles W. Eddy of Readsboro, Vermont; Graham Carey, of Jamaica, Vermont; John E. Volkert of Orlando, Florida; Miss Aida Smith, of Flemington, New Jersey; H. F. Mahle, of Kutztown, Pennsylvania; Mrs. W. L. Ballou, of West Nyack, N. Y.; Herbert S. Allen, of Manchester, New Hampshire. Howard Laskey, M. D., of Carolina, Rhode Island, cited the evidence in medical journals as to the toxic residues of certain poison sprays, which cannot be removed from produce by washing or other means before the foods are consumed.

In his lecture on "Organics and Fertilizer" on the second morning of the conference, Dr. Pfeiffer said he wanted more or less to continue where he had left off the day before. He stressed first the difference between scientifically-arrived-at facts, and statements of opinion.

"The scientific method," he pointed out, "consists essentially of observations as correct, thorough and painstaking as possible, then the drawing of conclusions from these observations, and then re-checking them with further experience and observation —a constant process of learning. Everyone naturally has 'opinions', but it is essential to the development of a science of organics that we all gradually learn to leave them aside."

He said further that it would be living in the past to say that the chemical industry and the "chemical people" do not know about organic matter. He referred, in this connection, to the fact that the national chemical fertilizer industry gets out "one of the best little pamphlets on organic matter that I have ever seen." In this same talk, the speaker remarked that "at the present moment, if you read scientific literature you will find an increasing amount of *evidence* regarding the benefits of

organic matter. The same is true as regards *evidence* of the limited value of chemicals."

"Today, progressive scientists doubt the complete validity of the Liebig Theory of Chemical Fertilizing," Dr. Pfeiffer went on to state. "It is not any longer necessary to fight it, but it is necessary to investigate its errors, because they can teach us something."

The lecturer continued with a scientific presentation from which only a few highlights can be quoted here. One of the things he pointed out was that relatively recent researches have shown that essential mineral elements may become "available" to plant roots under the influence of root secretions even though these same elements, not being water soluble, do not show up as "available" in the test tube. The importance of bacterial life (it in turn needing the presence of just the right amount of soil moisture) in connection with "availability" was also shown. Here, it was further pointed out, it is also necessary to keep in mind whether the bacteria present are humus-forming bacteria or "breakdown bacteria."

Dr. Pfeiffer told of further studies on nitrogen availability, made since publication of the material on this subject in the Summer, 1952 number of Bio-Dynamics. A brief report on these is given on page 30 of this issue.

He stressed the fact that the Starter action can be enhanced if humus-containing organic matter is applied to fields.

He quoted from the April, 1952 number of The Scientific Monthly statements to the effect that *we do not fertilize the plant, we feed the microlife, and it in turn produces what the plant eats and uses.* He said this ought to be learned by heart by every grower, and he referred his hearers to the article itself: "Feed the Soil," by F. Lyle Wynd.

An approach to more exact observation on the grower's part of the plant itself in its development from seed through the growth of root, stem, leaf and blossom back to a new seeding was given by Alice Heckel in the lecture that followed. Basing her presentation on the work of the German botanist Dr. Gerbert Grohmann, whose work is well known in Europe although his books have not appeared in this country, she illustrated her talk with slides from his drawings. It was shown how the metamorphosis of form to be observed in the individual plant results from an interplay of 4 forces: the linear, ray-like tendency in the stem and the horizontal expansion in leaf growth, and the cyclical suc-

cession of the forces of expansion and contraction. These developments of Goethe's botanical observations, essential for a more than merely "mechanical" understanding of the plant, were developed further by her in a second lecture on the fourth day of the conference.

In the evening of this second day, Mrs. Erica Sabarth presented fascinating material on the diagnosis of health and disease in plants by means of leaf coloration. The lecture was illustrated with colored and black and white slides. Those present at the conference have asked that this material be published in *Bio-Dynamics*. So the editors expect to bring it out in the next issue.

Continuing this running chronicle (selected from 113 pages of pencil notes) which aims at giving B.D. people unable to be at the meeting at least a little notion of what went on during the 4 days: the second afternoon began with a visit to the Bio-Chemical Research Laboratory. Showing the conference participants through the laboratory, Dr. Pfeiffer devoted a large part of his on-the-spot exposition to the story of the Starter which was discovered and developed there, and to the principles underlying it.

The rest of that afternoon, like many sessions of this and previous conferences, was devoted to questions and answers and exchange of practical experiences. Among the most valuable periods of the B.D. meetings, such sessions do not lend themselves to presentation in a running report like this. Participants were urged by the editorial staff of this quarterly to write up their own experiences and observations and send them in for publication. They will be most heartily welcomed. (Needless to say, this "invitation" holds also for those who were unable to be present).

Dr. Pfeiffer's third morning lecture was entitled "The Life of the Soil." In it he quoted, from various official sources, observations which showed that the average state of U. S. soils in regard to their organic matter content is already at the danger level. Pointing out further that that element or factor which is most deficient is the one that determines the issue, he said that the question was not so much one of absolute values as of *balance* as regards the mineral matter and the organic matter in a soil. He added that frequently a poor soil can be made fertile by bringing in such a state of balance. Moisture also comes into this picture.

In order to produce one pound of wheat, 500 lbs. of water are needed. Alfalfa and corn need up to 800 lbs. of water per 1 lb. of green matter. In other words, water is the limiting factor for yield. Air for the microlife, and particularly for the nitrogen-fixing bacteria, also comes strongly into the total soil management picture.

"There is no nitrogen problem if we treat our soil correctly," he continued. "A proper nitrogen management means aeration of soil, control of water and of soil acidity. Furthermore, through developing a proper soil structure with a high organic matter content one can build a moisture reserve to last 6 to 8 weeks into a drought period instead of only 2 weeks.

"There are relatively few soils now which hold moisture in such a way, but many soils can be built up and restored to such a condition. We need cultivation and aeration of the soil. The problem is that the present social-economic structure of American agriculture doesn't allow the farmer time to cultivate as much as he should. Cultivating a soil four times instead of twice can frequently double its air and water content. The combination of organic matter and proper cultivation can achieve optimum results. I really think the farmer ought to be subsidized for having well-cultivated fields instead of, as at present, for buying lime and fertilizer. And when you add compost to a field, remember it is not a matter of *how much* compost, but *how good* a compost."

This, the third, morning session came to a close with reports from Mr. and Mrs. Walter Stuber of Golden Acres Farm, Newtown, Pennsylvania, and Morgan Wolfram, their manager. In introducing the owner of this progressive B.D. farm, Dr. Pfeiffer referred to the high degree of mechanization which blends ideally with the organic management at the Stuber farm, and added that "the highest possible degree of mechanization is a necessity to the farmer's survival in the United States today." The reports of Mr. and Mrs. Stuber on the work of the farm in general and on their apiary appear elsewhere in this number of Bio-Dynamics.

In the afternoon Peter Escher gave a composting demonstration, showing both the use of the B.D. preparations and of the Starter. He used a *root feeder* attachment on a hose in applying the Starter—with the material in a tea bag in the little compartment through which the water passed. Thus it was easily put into an already-set-up manure heap.

That evening Richard Kroth, the painter, gave a lecture on "Color as a Language of Plant Rhythms."

The final day of the conference was opened with a lecture on "Apple Tree Animals," by Evelyn Speiden, secretary-treasurer of the Bio-Dynamic Farming and Gardening Association. Dr. Pfeiffer, in opening the session, said that while Miss Speiden needed no introduction to friends of Bio-Dynamics, he wanted to pay special tribute to all that she has done and is doing, especially in connection with the making and distribution of the B.D. Preparations and the handling of the voluminous correspondence, and in general "keeping our little organization alive and organized."

Miss Speiden developed the ecology to be studied in connection with "one old apple tree' citing observations of nearly 500 kinds of insects that come to feed there, besides small animals that come for fallen apples, others that come to feed on them, etc. From this she led into a listing of some of the specially harmful orchard insects and what can be done against them and their depredations. She stressed, among other things, the importance of encouraging insect-eating birds to nest in the orchard.

That afternoon Wilko von Brederlow and Howland Vibber gave a field demonstration on the bio-dynamic care of fruit trees. This was followed by another question and answer period.

In his final lecture, concluding the sessions, Dr. Pfeiffer summed up and brought together what had been developed at the various meetings of the conference. He spoke also, at some length, of the growing scientific realization of the importance of the study of light in relation to plant growth. He said he was convinced that new studies of photosynthesis, now in their beginnings in various places, would result in knowledge of tremendous practical advantage in relation to the feeding of the human race. Whether these studies would bear practical fruit "in ten years or in fifty years" cannot be predicted as yet, but it is sure that science is at the threshold of important new developments.

FARMER'S FOLLIES

CHARLES W. EDDY

The title of this article, "Farmer's Follies," by Charles W. Eddy, was suggested to him by Edward H. Faulkner's book "Plowman's Folly." Even many who follow Faulkner's suggestions, do use a plow for putting new fields into production. The Eddys have been successful in developing high production land from worn out pasture without using plow, harrow, or spade. They also conduct their gardens without weeding, hoeing, or cultivating. In his article Eddy explains how they developed techniques of gardening without these processes.

Thirty-nine years ago, when we were first married, a cousin of mine told me, "In order to be a good farmer never have a garden any larger than your wife can conveniently take care of." This was good advice. For the first time, however, after thirty years of experimenting, we did have such a garden. Between the time of planting and the time of harvesting my wife had complete charge of it and yet did nothing, for nothing demanded her attention. There were no weeds, no destructive bugs, and the earth was moist and soft.

That was what we called our "No-Garden"; that is, no plowing, no harrowing, no cultivating, no spading, no weeding, no commercial, chemical fertilizers, sprays, emulsions, powders, or weedkillers, no artificially applied moisture, and as I have already indicated almost "No-Labor."

Please don't misunderstand me. I do not mean that our garden was not plowed, harrowed, cultivated, or hoed. I do not mean that there were no fertilizers used or that there were no preventive measures employed to discourage the bugs and weeds. What I am saying is that we did not have to perform any of these operations ourselves. There were many others who were willing, yes, even eager, to do all of these things for us. We paid them nothing except to feed them and give them a place to live. We did not have to clothe them because they wear no clothes. The earthworms, bacteria, birds, toads, yes, even some plants commonly called weeds, worked together to do all of these services for us and in a much better, surer, safer, and more complete manner than we do them ourselves. Even the snakes eliminated the mice and moles, thus performing a valuable service. Never before did we get such good results, though for our first thirty years of gardening we clung faith-

fully to part chemical and part "well rotted" manure methods.

I say "well rotted" advisedly. I was talking with a man in Maryland, who was working in his garden. After looking at the pile of fertilizer that he was using, I said, "We use only thoroughly composted manure in our gardens." He said, "This is well rotted manure." I said, "Before using the manure in our gardens, we pick up a generous handful, rub it together between our hands, and then smell of it with a deep inhaling breath. If it smells good enough to eat, we know that it will make good food for our garden and good food for us." And then I said, "Would you care to make a similar test with that 'well rotted' manure of yours." He said, "No."

I have often brought a handful of our compost into the house to let our guests smell of it. After it is examined for odor and consistence, I tell them that it is made from dried leaves, old hay, bedding straw saturated with urine, sod, roots, hayseed, garbage, and cow manure. Only then do they turn up their noses, and what faces they do make!

The space that we selected for our present garden, on our Vermont farm, had not been touched by agricultural tools or machinery for some twenty years, in fact, no commercial fertilizers, or sprays had ever been used on the farm to any great extent.

Our state college soil test reports were not very encouraging. Out of twelve samples, three were reported poor and nine, very poor. For the first year the college recommended that we use 400 pounds of 8-16-16 fertilizer, 8 to 10 tons of manure, and 1½ to 2 tons of lime per acre. Since we decided on the organic methods before planting the garden, we used none of these recommended materials. We used humus from our compost pile and "well rotted" manure.

Five years ago we began to develop our "No-Garden" by eliminating weeding. We had ten strips of soil running north and south, each strip fertilized differently, using natural rock, hard wood ashes, compost, and "well rotted" manure. Across these strips we planted 40 different kinds of vegetables running east and west, forming 400 miniature gardens each three feet square.

Where we used "well rotted" manure, the weeds grew so fast that they choked out the vegetables. We harvested no crops at all from these sections. In the parts of the garden where we used no "well rotted" manure the vegetables grew so rapidly that there were not enough weeds to do any damage.

When uncomposted manures and cover crop materials are used, weed seeds are planted; since these are applied before the crop is planted the weeds get a head start. When only thoroughly composted materials are used for fertilizers, no weed seeds are present; hence, the crop has a chance to grow freely and fortify itself against the stray weed seeds.

At the end of the season we made a most valuable discovery. We turned over an old barn door which had lain in the field for several months. Although the surrounding soil was packed and hard, every grass blade and sod root beneath the door had changed to soft, rich, humus. This spot had not been cultivated or worked in any way for many years, and yet where the door had been lying, it was completely plowed, harrowed, and fertilized by the earthworms.

With the old barn door in mind we planted our strawberry bed. We selected a spot on a slightly sloping field with the uncut hay, two foot high, still standing. With a spade we removed small pieces of sod, spacing all holes 20 inches apart, and filling the holes with soil from our 30 ton compost pile. We then put strawberry plants in the holes of rows 2, 3, 6, 7, 10, 11, etc. The remaining holes were kept vacant to receive the runners for next year's plants.

After the strawberry plants were all set out, we covered all spaces between the holes, grass and all, with 17 inch x 17 inch fire resistant shingles that came from an old barn. The next spring when we returned to the farm in May, only strawberry plants were growing in our strawberry bed. Soft, rich soil was under the shingles, and walking on them gave the sensation of walking upon a mattress. We left the shingles on the garden permanently, except to lift one occasionally to investigate the soil.

These investigations revealed a veritable menagerie. Lifting one shingle, I found two snakes, one green and one brown, each a foot long. There were also many crickets. The soil was well occupied by earthworms, and myriads of their excavations were visible; starting at the surface of the ground. Planted in this way the strawberries seemed to do exceptionally well. At one time 49 strawberries were counted on one plant.

Last year we used the same principles in preparing our vegetable garden for this year. After we had picked the last of our beans, peas, herbs, tomatoes, squashes, peppers, and corn; after we had dug the last of our potatoes and turnips; and after

we had harvested the last of our cabbages, lettuce, carrots, beets, and radishes; we pulled up all standing vines and stalks and dropped them where they had been growing. Then we covered the garden with a foot of mulch. As with our other experiments, at planting time the following spring, all of the vegetation, with the exception of the larger stalks, beneath the mulch had changed to rich, dark brown, humus. Some of the lower layers of the mulch had also changed to humus so that a foot of material added in the fall had compressed and broken down to three inches.

Being concerned about preserving the organic life of the soil, we were careful to prevent exposure of the soil to the air and sunshine. In planting, we raked back the mulch one row at a time and replaced it immediately after planting the seeds. Plants such as beans, corn, peas, onions, and potatoes grow through the mulch, if it is not too thick; whereas, the smaller plants such as lettuce, carrots, beets, and radishes require removal of the mulch about the time of germination. Where the mulch was removed, it was replaced after the plants had grown a few inches.

Our potatoes, we planted, in straight rows, a foot apart and covered them with only half an inch of soil. Eight inches each side of each row of potatoes we planted a row of beans by dropping them on the ground and pushing them two inches into the soil. We then covered the three rows with two inches of the mulch that we had temporarily removed. After growing through the mulch, the potatoes and beans were much more closely mulched than they could otherwise have been.

As soon as the tubers started to form, they arched themselves above the ground, and upon lifting the mulch, we could see the growing potatoes. We then added more hay around the plants to protect the tubers from the sun. They were extremely easy to harvest. Due to the excessive rains in our locality most of the potatoes were ruined by rotting. Since our potatoes were not covered by the saturated soil, most of them did not rot.

The three rows of vegetables, consisting of one row of potatoes and two rows of beans, intermingled into a solid mass of foliage nearly four feet wide. Not a weed appeared in this section all summer.

The previous year the beans and potatoes were planted in alternate rows. They did quite well until the deer were attracted to this tender, toothsome, delicacy. Therefore, we did

nothing to this part of the garden for the rest of the season. We did not even mulch it. In the fall the weeds stood two to three feet high, and the soil was packed and hard. This we covered, weeds and all, with a foot of miscellaneous mulch as we did the rest of the garden. The following spring upon raking the mulch to the sides of the patch we discovered once again that the weeds had all changed to soft, rich humus. Here we sowed buckwheat and white clover, and scratched the ground with a rake to cover the seeds. How the buckwheat and clover did grow!

For next year we are planning only three operations with one repeated. This will be our program: plant, mulch, harvest, mulch. For mulch we use old hay, and fresh hay, weeds, yarrow, ferns, blackberry vines, yes, even brush that the town workmen cut along the road and leave there. Any dry vegetable matter will do. A few leaves are desirable to replace the trace elements removed by crops. Too many, however, are not satisfactory, because they break down into humus too rapidly. For this reason it is not good to use uncomposted animal manures and garbage. If these last materials are used they should be applied to the ground before the mulch is added. Thus they contribute to the fertility of the soil without destroying the protective value of the mulch.

Plowing, harrowing, and spading break up the soil preparatory to planting. But they also bury the top soil, making it less available to the crops. Because the abundance of earthworms and other organisms in our soil perform the same functions in loosening the ground without disrupting the top soil, it seems folly for us to plow, harrow, or spade.

Cultivating keeps the soil friable so that it will not interfere with the development of the hair roots, and weeding prevents the weeds from dominating the garden, and stunting or destroying the food crops. But both of these operations tend to cut many of the hair roots and remove some of the smaller plants. Since the earthworms also perform the same beneficial functions without detriment to the crops and the mulch prevents weeds from germinating, it seems folly for us to cultivate and weed.

In our garden we follow the suggestions made in the booklet "Companion Plants," published by the Bio-Dynamic Farming & Gardening Association, Inc., but now temporarily out of print. This book gives information about plants which directly and indirectly aid each other, plants which oppose or harm each

other, instances where a small ratio of a certain plant aids growth of others, though a large ratio hinders and harms, plants which repel harmful insects, plants which attract useful insects, plants which repel animal pests, plants which repel or reduce danger from fungi or other plant diseases, plants which are beneficial to animals, and plants which attract birds. We have already been successful in planting peppermint with cabbages to discourage the cabbage worm butterflies; nasturtiums with squash to eliminate squash bugs; a few horse-radish plants at the corners of our potato patch to produce better potatoes; garlic with roses which help each other; beans and corn for their mutual benefit; stinging nettle with tomatoes to improve their keeping quality; and white geraniums which act as Japanese beetle traps. We also separate our sunflowers and potatoes, since they stunt each other; and we try to keep buttercups out of our gardens because they destroy legumes. Since using these methods, we have had far fewer destructive insects than previously. We have seen no tomato worms, been beetles, squash bugs, Japanese beetles, corn borers, or cut worms during the past three years and a few potato bugs only one of these years. Therefore, to us it seems folly to add needless expense and labor by spraying to combat insects.

By a counting test method, we found our compost pile to contain as estimated 50,000 earthworms many of which were about 4 inches long and 3/8 of an inch in diameter. It is easy, therefore, for us to believe the statement that has been made, that earthworms under the most favorable conditions produce 30 tons of fertilizer per acre per year. So, for us it seems folly to add chemical fertilizers.

If the fertility-mineral-humus content of the soil is removed with a pay crop, it is usually considered necessary to replace it with mineral fertilizers and green and animal manures. In our garden, we originally established the soil fertility by applying compost made with Bio-Dynamic preparations and by treating the soil directly with Bio-Dynamic bacteria. With our well established earthworm and bacteria population, therefore, we think it may be necessary in the future to add only mulch materials twice a year, which gradually break down into humus and add the valuable materials that the pay crop removes.

That our fine organic humus, when mulched, retains so much more moisture than the coarser sandy soils was demonstrated in our garden when this retained moisture carried our

growing vegetables through forty days of drought, with no watering on our part. Therefore, it seems folly for us to apply moisture artificially.

In the past five years we have had more and tastier vegetables than ever before with much less time, money, and labor devoted to our gardens. Our experiments are small, but the work is extremely interesting. We are only following nature's cycles of processing which have apparently been successful for untold generations, yet by so doing, we are able to accomplish what many believe to be impossible. It is thus that we have progressively eliminated nearly all the agricultural operations that are practiced by millions of farmers and gardeners in the United States.

AVAILABILITY OF NITROGEN, PHOSPHATE AND POTASH IN SOILS

Under this heading a short communication was made by the writer in BIO-DYNAMICS, Summer 1952, Vol. X, No. 3.

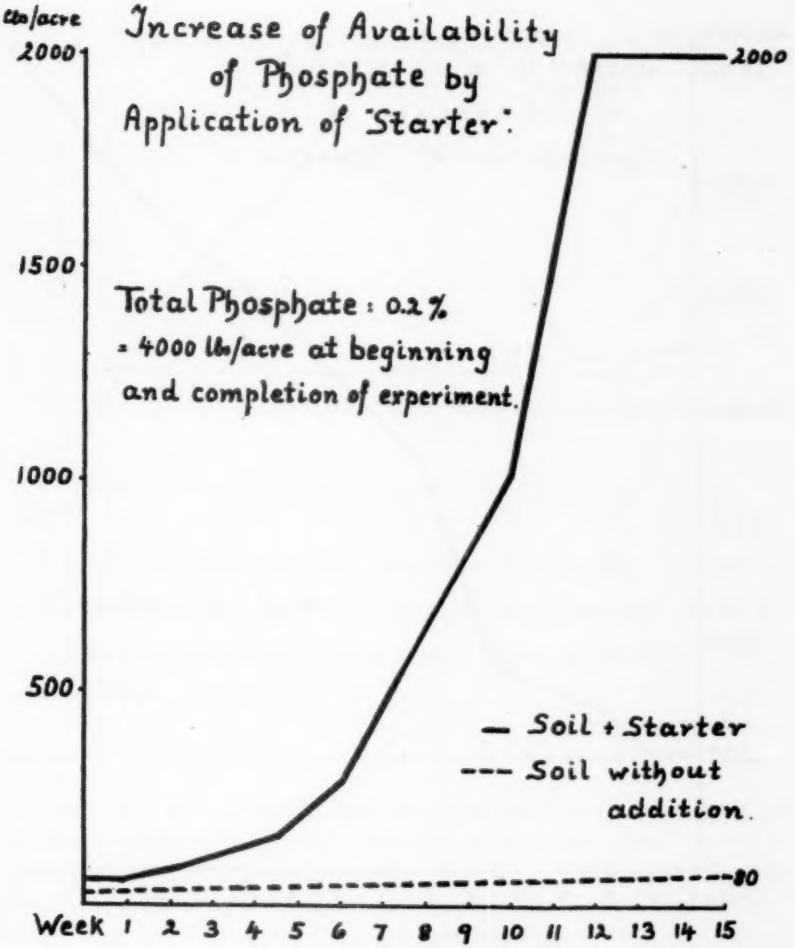
The experiment described there was continued. The later findings are reported herewith.

Increase of Availability of Soils as result of Application of Com-Co Bacterial Spray

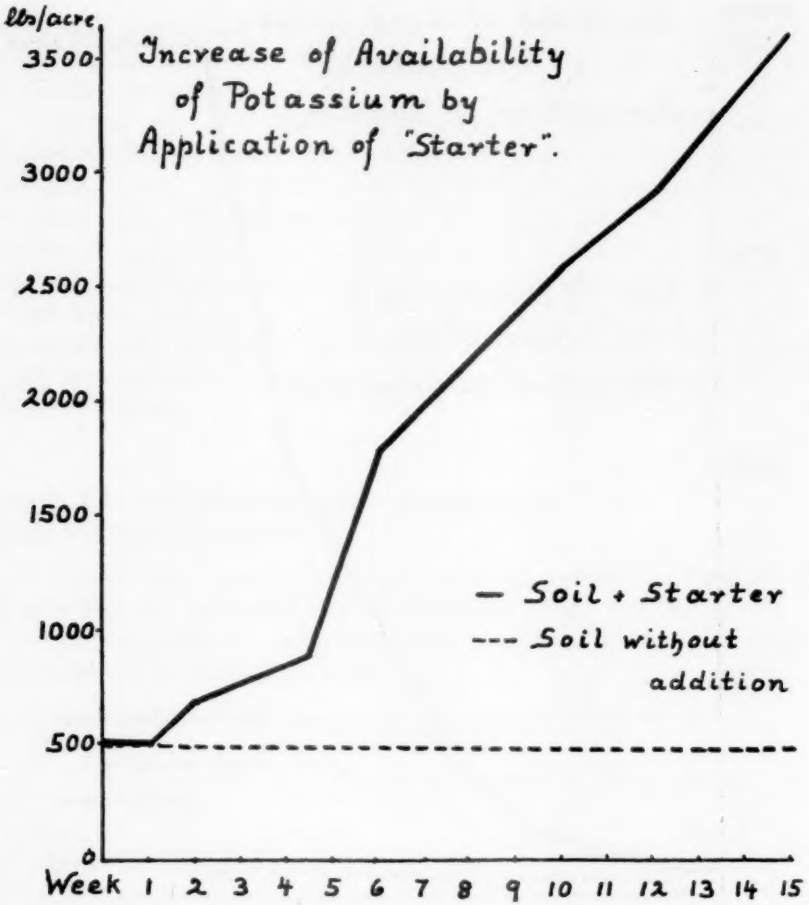
An Adobe Soil was treated with the Bacterial Spray and kept moist for 15 weeks.

Findings of available minerals:	Nitrates lbs/acre	increase	Phosphates lbs/acre	increase	Potash lbs/acre	increase
At start	64	–	30	–	500	–
After 1 week	96	50%	60	100%	500	0%
After 2 weeks	192	200%	80	166%	700	40%
After 4½ weeks	320	400%	160	433%	900	80%
After 6 weeks	384	500%	280	833%	1800	260%
After 10 weeks	310	384%	1000	3233%	2600	420%
After 12 weeks	128	100%	2000	6566%	2900	480%
After 15 weeks	162	153%	2000	6566%	3600	720%
Control after 15 weeks			80	166%	500	—%

These figures show that there were no appreciable changes in the control soil without B.D. Starter Spray but that availability increased to a maximum with the spray up to 15 weeks. These available minerals may help the plants grow faster. This is thought to be an improvement for organic methods because in general it was observed that organic fertilizers and composts are slow of action and that a considerable period of time is necessary before the organic effects show up in the soil. It is frequently described in the literature that manures and green ma-

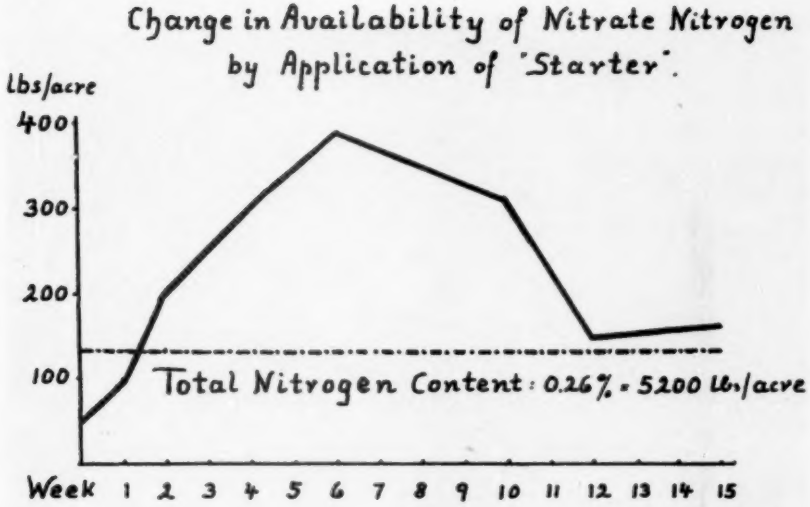

lbs/acre
Increase of Availability of Phosphate by Application of "Starter".
2000
1500
1000
500
2000
Total Phosphate : 0.2 %
= 4000 lbs/acre at beginning and completion of experiment.
— Soil + Starter
--- Soil without addition.
80
Week 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

nuring do not show up during the first three or more months or for the first crop but become effective only after a long "incubation" period in soil. Hence the fact that mineral fertilized fields and plants produce a fast growth with the maximum effect right after application (first crop), while organic treatment is slow in coming, with a maximum effect much later, for instance for the second crop. Organic experimenters were frequently puzzled in comparative tests that fertilizers "did better." They should have waited until the organic effects came through and then they would have observed a slow but longer lasting effect. The use of the B.D. Spray may help here to overcome



the slower beginning and produce earlier results. Especially in fast growing plants which are harvested before they come to maturity (green vegetables such as spinach, lettuce, etc.) this can become important.

It should be remembered, however, that physical soil conditions as well as proper moisture here are even more important, such as loose, crumbly, well aerated structure, for it cannot be expected that the microlife can become effective in a tight, caked, flooded or dry soil.


Change in Availability of Nitrate Nitrogen by Application of "Starter".
lbs/acre
400
300
200
100
Total Nitrogen Content: 0.26% = 5200 lbs/acre
Week 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

The fluctuation in nitrate nitrogen is due to bacterial action, since no reserve (total) nitrogen has been consumed.

One interesting result may be reported here as illustration. On this writer's farm, field corn was grown this year on a field treated with manure and Starter Spray. The first seeding of corn failed because of continued rains and cold. The Starter Spray was applied before the second seeding. This corn grew in 65 days to a height of between 9 and 11 feet, with many plants having two ears. The entire stand of this corn was far better than any other experienced, even when planted earlier. Corn planted later in June was harvested for silage early in September of the described height with a yield exceeding 17 tons per acre.

Corn (Halbleib Organic Seed, Krug's open-pollinated) grown on Dr. E. Pfeiffer's farm, Chester, N. Y. Stand 9 to 11 feet high, after 65 days of growth. The soil was fertilized with 10 tons of barnyard manure. B. D. Compost Starter treated.

EHRENFRIED PFEIFFER

GOLDEN ACRES FARM

WALTER STUBER

I became interested in actual farming many years ago through discussions with Dr. E. Pfeiffer about the subject and through my interest in healthier food for human consumption.

About five and a half years ago I bought a farm covering 189 acres; two and a half years ago I acquired the second farm on which we presently live, and a year ago another one, bringing the total to 370 acres. About 260 acres are tillable, 110 acres are in woodland and are taken up by the various buildings and roads. All the land is adjacent to the original farm and more or less follows a little creek to its source.

I have lived all my life in cities and had no idea where and how to begin on a farm. Dr. E. Pfeiffer explained to me various possibilities and from them I picked the one that looked best suited for what I had in mind—I decided on a dairy farm. I wanted to build up a bio-dynamic farm that would give all the families connected with it home grown bio-dynamic food the year round. This we have now pretty well accomplished. We have our own raw milk, chickens, turkeys, eggs, beef, wheat. We stonegrind flour and bake our bread; and we have our own honey and vegetables. Within a few years we shall also have enough fruit from the several hundred trees and berry bushes that were planted last year. Our goal here is to be self-sufficient throughout, i.e. we will not raise more livestock than we can support with our own feed. Improved soil fertility and with it increased yields are to make this program possible; and to gain this point we needed large amounts of bio-dynamic compost. This need of compost was ideally met by our dairy herd.

The original, or "Guernsey Farm", was built for a large herd of steers. We had to change this to take care of the dairy cows. And we have now a herd of about 100 registered Guernseys. In our dairy barn I was especially anxious to install laboursaving machinery and devices. We have barncleaners, a silo unloader in each of our two silos, in order to feed corn and grass silage alternately; in the milkhouse we have a milkcan conveyer, in the mow a haydryer and a number of other such laboursaving installations.

The second or "Heifer Farm", comprising about 58 acres, has a loafing barn for about 25 heifers, which stay there until they are ready to have their first calf.

The third farm of about 123 acres, called the "Steer Farm", is still in its early building-up stage. There, we are presently working to provide facilities for 50 steers and a large flock of chickens. So far we have had a small chicken operation on the "Guernsey Farm". We started there every spring with about 800 one day old chicks—one half became laying hens, the other half was caponized. This operation was so successful and promising that we intend to increase our poultry flock to as many chickens as we can feed in line with our overall plans. We are moving this expanded operation to the steer farm, letting the birds run together with the beef cattle.

We have worked out a new system to build compost heaps all through the year without being hindered by bad weather. That is, we constructed a 100 x 100 feet concrete platform about 100 feet away from the barn and connected with same by a concrete apron. On this platform we build up our heaps, about four feet high and six feet wide on a twelve inch layer of sawdust mixed with some earth. If the need arises to turn the piles over, we do this with a front-end loader which we also use for loading compost on the manure-spreader for distribution over the fields. This concrete platform takes care of 500 tons of compost. The manure, together with the chopped straw which we use as a litter, is moved by the barncleaner to a manure-spreader with power take-off, and from there unloaded onto the concrete composting platform. The spraying of the bio-dynamic starter is connected with this operation. In future we intend to have a cross-belt to take the manure straight up to the platform, from where we can then build the compost heaps with the front-end loader. We collect whatever garbage is available on the farm and grind it with a Shredder; thereafter it is added to the compost heaps. Quite astonishing is the fact, that these compost piles, treated with the bio-dynamic starter, are free of flies; so is, by the way, also the dairy barn. This, however, was achieved by the installation of Detjen Electric Fly Screens.

We naturally use bio-dynamic preparations throughout. When I say "we", I primarily refer to my manager, Mr. Morgan Wolfram, a graduate of Penn State College, who has been with me from the beginning, who has done all the hard work connected with the changeover to a dairy farm, building up our herd and building up the very much run-down land; and who has given me most of the ideas for the improvements we have made. Quite obvious and gratifying is the difference in

soil fertility and crop yield between the original farm operated bio-dynamically for five years now, and the two farms acquired several years later. In fact, the average organic matter content on the "Guernsey Farm" has increased from 1949 to 1951 from 1.86% to 2.01%. At a recent meeting of neighbourhood farmers, the speaker mentioned that out of 1000 soil samples sent to an Eastern State College, there were only two that had an organic matter content of over 2%. We are not buying any more fertilizer; and we have almost reached our goal of raising all our own feed and seed.

Yet I wish to emphasize, that such a program of converting run-down land into a productive bio-dynamic farm with crop yields high enough to be self-sufficient, is not just a matter of a few months. It takes time and effort including failures. This conversion took us about five years on the first farm. However, I feel that in its process we have learned how to reduce the time to about two or three years. It is our hope that we shall be able to prove this on the newly acquired farms. If we succeed, we may have created an example for other farmers who wish to improve their soil in such a way.

Only this year we have started the one-day pasture rotation. We have subdivided the pastures into 35 two acre fields by way of electric fences. Thus, the cows are moved each day to a different pasture, whereby the grazing areas are allowed sufficient time to recover without disturbance. After the cows are turned off the pasture, we go over it with a Scotch harrow to distribute the manure; then we clip the area in order to discourage weed growth, thereby preventing its going to seed. At the same time the regrowth of grass is accelerated. In the years to come we hope to install a complete irrigation system, in order to maintain healthy pasture growth throughout the dry summer season. In springtime, when the "garlic-problem" arises, the heifers are sent out one day ahead of the dairy cows. The animals have a great liking for the garlic; and by the time the cows have arrived, a great deal of the undesirable weed is eaten off. This method saves the milk from becoming flavored with garlic.

For pollinating our hay fields and orchards we have 27 beehives, and their honey amply supplies all the farm families. We have an excellent beekeeper right on the farm; my wife takes care of all our bees with remarkable success.

Morgan Wolfram, together with three men, operates the

farm on an incentive basis. These men live with their families on the farm.

At the present time our main cash crops are milk which we sell to a local dairy; and wheat, which goes to a distributor of bio-dynamic whole gound flour and cereal, W. Buschman in Chester, N. Y. Later on, however, we plan to install a little dairy ourselves and sell certified raw milk. We also hope that eventually we will have saleable amounts of chickens, eggs, vegetables, fruit and honey.

There is a great deal to be done to complete this development; but this will at least give you an overall picture of our plans. Primarily we are trying to show here that the bio-dynamic method is applicable to large scale farming as well as the small vegetable garden. Above all, it is our hope, that through all this we shall encourage others and show them, how this can be done economically.

The trend of development on the farm can best be illustrated by a few figures.

Total Milk Production		Average Milk Production per Cow	
1949	308 713 lbs	1949	7 946 lbs
1950	349 323 lbs	1950	8 709 lbs
1951	356 104 lbs	1951	9 161 lbs
Total Butterfat Production		**Average Butterfat Production per Cow**	
1949	14 445 lbs	1949	371.8 lbs
1950	16 363 lbs	1950	412.7 lbs
1951	17 244 lbs	1951	443.6 lbs

(Figures from official testing record.)

Soil improvements show up in changes of acidity, nitrates, available phosphates, organic matter and bacteria count. Eleven to twelve fields were tested every year at the same time.

On the first farm unit	1949		1951	
Average pH	5.8		6.0	
" Organic Matter	1.86%		2.01%	
" Nitrate Content	22	lbs per acre	26	lbs per acre
" Phosphate Content	103	lbs " "	136	lbs " "
" Potassium Content	110	lbs " "	132	lbs " "

The bacteria count was tested only on a few fields but showed an increase of at least ten times.

The two units which were taken over later show both much lower figures in organic matter and nitrates, in fact down to the critical level. These units were fertilized by the previous management; but no attention was paid to the organic question.

The yield of wheat in 1951 was 40 bu per acre,

The yield of corn in 1951 was 78 bu per acre.

(From a lecture given at the Bio-dynamic Conference in Spring Valley, N. Y., summer 1951.)

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